Subject: Baffle spacing, crossovers and phase angles
Posted by Wayne_Parham on Thu, 05 Apr 2001 06:06:16 GMT
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I'm not a big fan of the phase "time aligned" as it is sometimes used to describe loudspeaker systems. Speakers contain reactive elements in the mechanical, electrical and acoustic domains, and this prevents them from having zero phase, or even fixed phase of a specific amount. Where there are reactive elements, perfect time alignment is impossible. An approximation can be found, within certain constraints. Destructive interference can be limited at specific target locations. But time alignment at all frequencies and locations is not possible.As an example, look at the simplest system. A first-order system will exhibit a maximum of 90 degrees phase shift. The speed of sound is 13548 inches per second, so 1/4 wavelengths (90 degrees of phase) are:at 10Khz - 1/3rd of an inchat 5Khz - 2/3rds of an inchat 1Khz - 3.4 inchesat 100Hz - 34 inchesAs a speaker enters resonance, phase shifts from about 90 degrees to nearly zero. As you can see, this causes a phase shift corresponding to two to three feet, if resonance is under 100Hz. If there is a crossover network, there will be shifts near the crossover region and the amount of shift moves. It is not fixed, and so cannot be corrected with baffle offset. Here again, an approximation can be implemented but perfect "alignment" cannot.As frequency nears the crossover frequency of a crossover circuit, the phase angle is continuously changing. For a tweeter, the apparent distance is nearer at cutoff and then is constantly moving away as frequeny rises. The woofer doesn't move the same way, because filter slope is the opposite direction. So the shifts are different, and they are not fixed in distance as a position offset is.This is why time-alignment cannot be accomplished with reactive networks or baffle position. It can be approximated, by aligning the radiators at the crossover point, and then frequencies above and below in the overlap region will be misaligned, but not by much. Most high-quality designs attempt to reduce off-axis nulls, which is a very valid design goal. But it is not actually time-alignment, and is only an approximation. A good solution reduces interference between subsystems, but I would not characterize this as being "time aligned."